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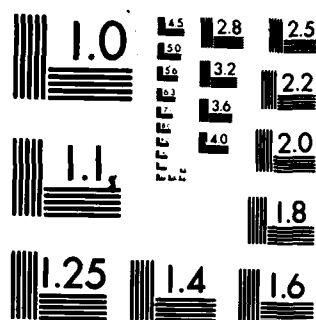
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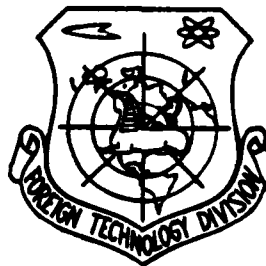


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# FOREIGN TECHNOLOGY DIVISION



LASER JOURNAL  
(Selected Articles)



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FTD-ID(RS)T-0017-83

## EDITED TRANSLATION

FTD-ID(RS)T-0017-83

12 May 1983

MICROFICHE NR: FTD-83-C-000662

LASER JOURNAL (Selected Articles)

English pages: 6

Source: Jijuang, Vol. 9, Nr. 5, 1982, pp. 26; 96;  
106-107

Country of origin: China

Translated by: SCITRAN

F33657-81-D-0263

Requester: FTD/TQCS

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PREPARED BY:

TRANSLATION DIVISION  
FOREIGN TECHNOLOGY DIVISION  
WP-AFB, OHIO.

FTD-ID(RS)T-0017-83

Date 12 May 19 83

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GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

Cho Yueh-Liang, Chen Cheng-hao, Ts'ui Ta-fu, Lu Hui-pin  
(Institute of Physics, Academia Sinica)

We have fabricated a double beam tunable TEA CO<sub>2</sub> laser. This instrument has a repetition rate of over 10 pps and a long operating life of 10<sup>6</sup> pulses of continuous operation for every change of gas. In addition, it has the following features:

1. Two laser beams oscillate coherently in the same medium, each beam being independently tunable between 9.2  $\mu\text{m}$  and 10.9  $\mu\text{m}$ .
2. Each laser beam can be output in a single transverse mode or in multiple transverse modes. The output power of each beam operating in the single transverse mode can be up to 0.5 trillion watts, while that of each beam in multimode operation can reach 1 trillion watts.

Some important structural features of this laser are as follows. In a glass cylinder 1 m long and with inner diameter 300 mm are placed the discharge/preionizer system and the gas circulation-cooling system. The laser has a gas generator and can operate using air as a source of gas. The two ends of the glass cylinder are sealed with French disks to which the mirrors for reflecting the two beams back and forth and the device for frequency and mode selection are attached.

Satellite Laser Ranging Research Group  
(Shanghai Observatory, Academia Sinica)

In this paper, we have given a fairly full discussion of the purpose, progress and plans for the next step of the satellite laser ranging work done at the Shanghai Observatory, Academia Sinica, during the past nine years.

We have given a brief description of the properties of the first-generation ruby laser ranging system. We have talked about satellite forecasts and work done by our laser ranging network, including names of organizations and purposes for which the information will be used. We have reported on the Nd:YAG laser experimental ranging system and the international joint laser ranging that we took part in. A brief discussion is given of the second-generation ranging laser that is expected to be completed in 1982.

#### PRECISE DETERMINATION OF TEMPORAL DIFFERENCE OF ATOMIC CLOCKS AT TWO SEPARATE LOCATIONS USING LASER PULSE TRANSFER TECHNIQUE

Laser Temporal Comparison Group  
(Shanghai Observatory, Academia Sinica)

Temporal comparison of two clocks at different locations is generally achieved by means of microwave techniques, television, LDRAN-C or moving one clock closer to the other. The first three methods have a lower accuracy on the order of 0.1 microsecond. Higher accuracy can be achieved by moving the clocks close together, but this method is rather inconvenient and cannot be used for frequent or prolonged comparison.

Laser pulse transfer technique is a new method for temporal comparison of clocks located at different places. We used a tunable



ruby dye laser and two electro-optic receiving systems to carry out temporal comparison between the two rubidium clocks in the clock rooms at Hsuchiahui and Sheshan of the Shanghai Observatory that are located 25.2 km apart. Within two to three minutes, an accuracy of comparison was reached that was within 10 nanoseconds. At the same time the comparison was made using the laser, a small caesium clock was moved from one clock to another for direct comparison. The results indicate that there was close agreement between the results obtained by these two methods.

This was the first time such a technique was used in temporal comparison in our country. The results obtained are rudimentary. We plan to make some improvements in our measurements in the near future so as to obtain better results.

Sung Cheng-fang, Han Shou-ch'un, Ting Ch'iang, Chi'i Fu-ti,  
Ku Wei-yi, Liu Hsiao-ch'un

(Anhui Institute of Optics and Fine Mechanics, Academia Sinica)

During their propagation through turbulent flows in the atmosphere, light beams not only suffer from intensity and phase fluctuations, but also undergo jittering and spreading which have detrimental effects on laser engineering. In the past, jittering and spreading were usually measured by means of photography or one-dimensional optical scanning. The former is not applicable to infrared light and requires complicated processing afterwards. The latter is not applicable to pulsed light, and has a lower degree of accuracy. These difficulties can be overcome by using video photography. However, the vast amount of data in the large data frequency band for the pictures is beyond manual processing, and even defies processing by the common microcomputers. We used the scheme of variable-speed scanning which allowed the microcomputer to automatically collect data and to do the computations. The set-up includes a video camera, a video recorder, visible frequency storage unit, data collector, microcomputer and pseudo-color monitor. The pictures are first taken and stored, then they are slowly read out. It takes about one second to read one picture into the microcomputer where computations are carried out for finding the effective diameter and the center of intensity. The variance for jittering and spreading can thus be obtained by averaging the results over several pictures statistically.

During August of 1981, we did an experiment on the jittering and spreading of a laser light beam in collaboration with Room 7 of Talien Chemical Physics Research Institute in the city of Talien. We used four lasers: a He-Ne ( $0.6328 \mu\text{m}$ ), a YAG ( $1.06 \mu\text{m}$ ), a HF ( $\sim 2.9 \mu\text{m}$ ) and a DF ( $\sim 3.8 \mu\text{m}$ ) laser. The distance of propagation was 880 m. The laser beam path was about 20 m above ground which

contained varied features. 70 sets of data were obtained in all. We also measured the He-Ne laser glittering, temperature pulses and the regular meteorological factors for the purpose of analysis and comparison.

Presently, we have used the pseudo-color monitor to analyze part of the data taken. The root-mean-square values for the YAG laser and the He-Ne laser drifting are respectively 7.2 and 8.7 mm, in agreement with theoretically obtained values. The diameter of spreading of the He-Ne laser in turbulent flow is 3 cm, also in close agreement with theoretical values. That for the YAG laser is 10.7 cm, which is several times the theoretically estimated value. The reason for this has yet to be established.

LASER GLITTERING IN THE RELATIVELY STABLE PROPAGATION LAYER  
NEAR THE SEA SURFACE

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Le Shih-hsiao  
(Ch'engtu Institute of Telecommunication Engineering)

During the autumn and winter of 1979 and the summer of 1980, we did an experiment on propagation of communication along the optical paths from T'uantao in Huangtao to Ch'ingtao, at the Chiaocho Bay. (Some of the experimental points were by the dock. 95% of the optical path was above the water surface). The experiment was carried out by means of a 10.6  $\mu$ m collimated beam at the heights of 8, 10, 16, 53 and 70 m, and for the distances of 4, 5, 7, 8, 10 and 21 km. We found that the laser glittering near the water surface had the property of being relatively weaker, while the glittering at 53 m and 70 m of height did not possess this property. This result has removed the myth that the region within 40 m above the sea surface is a "forbidden region" for laser propagation. It will be very helpful in the development of laser communication among the islands in the sea because of a reduction in cost. (The communication points located on mountain tops or high rise buildings require higher investments).

In this paper, an explanation of the above phenomenon has been given in terms of the viscosity of water vapor and energy exchange between the sea and the atmosphere.

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